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ADDENDUM

TO

FINAL ENVIRONMENTAL IMPACT STATEMENT

ADMINISTRATIVE ACTION - Proposed Approval of a
Strip Mining Permit for the Continuation of
Westmoreland Resources' Sarpy Creek Mine
in Big Horn County, Montana

Submitted Pursuant to the Montana Environmental
Policy Act Section 69-6504(b)(3), R.C.M. 1947

Prepared by

MONTANA DEPARTMENT OF
STATE LANDS

HELENA, MONTANA
January 16, 1975

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INTRODUCTION

On October 19, 1973, a draft environmental impact statement was released by the Department of State Lands on the proposed Westmoreland Resources' Sarpy Creek Mine in Big Horn County, Montana. The final environmental impact statement was circulated on December 14, 1973. After consideration of the comments received in response to the statements and after review of all application materials, the Department determined that Westmoreland Resources met the criteria set forth in the Montana Strip Mining and Reclamation Act and issued a permit to that company on February 1, 1974.

The company has applied for a renewal of that permit. In addition, Westmoreland Resources has applied for a new permit to convert fifty-five (55) acres of currently permitted "associated mining disturbance" to active mining and the addition of eight (8) acres of unpermitted land. This eight (8) acres lies in the S1/2 S1/2 S1/2, Section 23, Township 1 North, Range 37 East.

Since Westmoreland has submitted some new information concerning the general mining area and in particular the area proposed to be mined in year two of their operation, the Department deems it necessary to issue an addendum to the final impact statement supplementing but not reiterating the information contained in the statement. The addendum will cover the current level of knowledge and the proposed mining plan for the Sarpy Creek Mine; any information in this statement that conflicts with that in the final will supercede the material in the final.

GENERAL INFORMATION

Westmoreland Resources' Sarpy Creek Mine is located in Big Horn County, Montana, Township 1 North, Range 37 East. Initial mining commenced on Sections 25 and 26 of that township. During the first year of mining thirty-nine (39) acres of coal will have been uncovered; eighty-seven (87) acres of surface will have been disturbed by placement of box cut spoils. Haulage roads have affected thirty-five (35) acres, an access road fifteen (15) acres, and additional roads nine (9) acres. The rail loop and enclosed structures cover ninety-five (95) acres, topsoil storage areas eleven (11) acres, a settling pond ten (10) acres, and other facilities thirty-five (35) acres.

In total, the acreage affected during the first year of the operation will be three hundred forty (340) acres.

PHYSICAL FEATURES

Overburden and Interburden

At least three (3) core holes were drilled in the area proposed to be mined in 1975. The location of these drill holes, which are identified by number, can be noted on Exhibit 1, found at the end of this statement. The complete analyses of the holes are included as Appendix I.

The Department's current determinations, based on these analyses follow:

> Hole 489C - Most of the material below sixty-eight feet (68') has high SAR values (2.5-23.2); this material should not end up near the surface when backfilling and grading. Boron is high at various levels below 31 feet (4 to 4.2 ppm); these layers should probably be buried.

Phosphoric oxide

Hole 490C - This area has high SAR values below seventy-eight feet (78') (8.6-33.4), high boron below forty-five feet (45') (4-5.1), and high zinc in three layers below thirty-nine feet (39')(140, 140, 164 ppm). Special spoil handling procedures should be employed.

Hole 441C - The layers between ninety-nine (99) and one hundred sixty one (161) feet have high SAR values and should not end up at the surface when backfilling and grading.

Soils

Soils are generally covered in the final statement.

Hydrology

Hydrologic research in the vicinity of the Westmoreland Resources Tract-3 coal reserves near Sarpy Creek was begun in 1972 to determine pre-mining hydrologic conditions and any mining-related hydrologic changes there. Aquifers that might be affected by the mining operation are coal, siltstone, and sandstone beds, all of which are relied upon for stock and domestic water supplies. Mining will disturb three aquifers or aquifer zones: one in the Rosebud-McKay overburden, one near the Rosebud-McKay coal, and one near the Robinson coal. (See figure 1).

The aquifers are recharged laterally from the south and vertically from above and discharge laterally from the south and vertically from above and discharge laterally northward to outcrops and subcrops and vertically downward to stratigraphically lower aquifers.

Ground-water quality in the area is diverse; dissolved-solids concentrations range from 400 to 5,000 mg/l (milligrams per liter) in almost all samples. All waters are slightly alkaline, having pH values between 7 and 9. Chemical characteristics of ground waters and source aquifers correlate poorly.

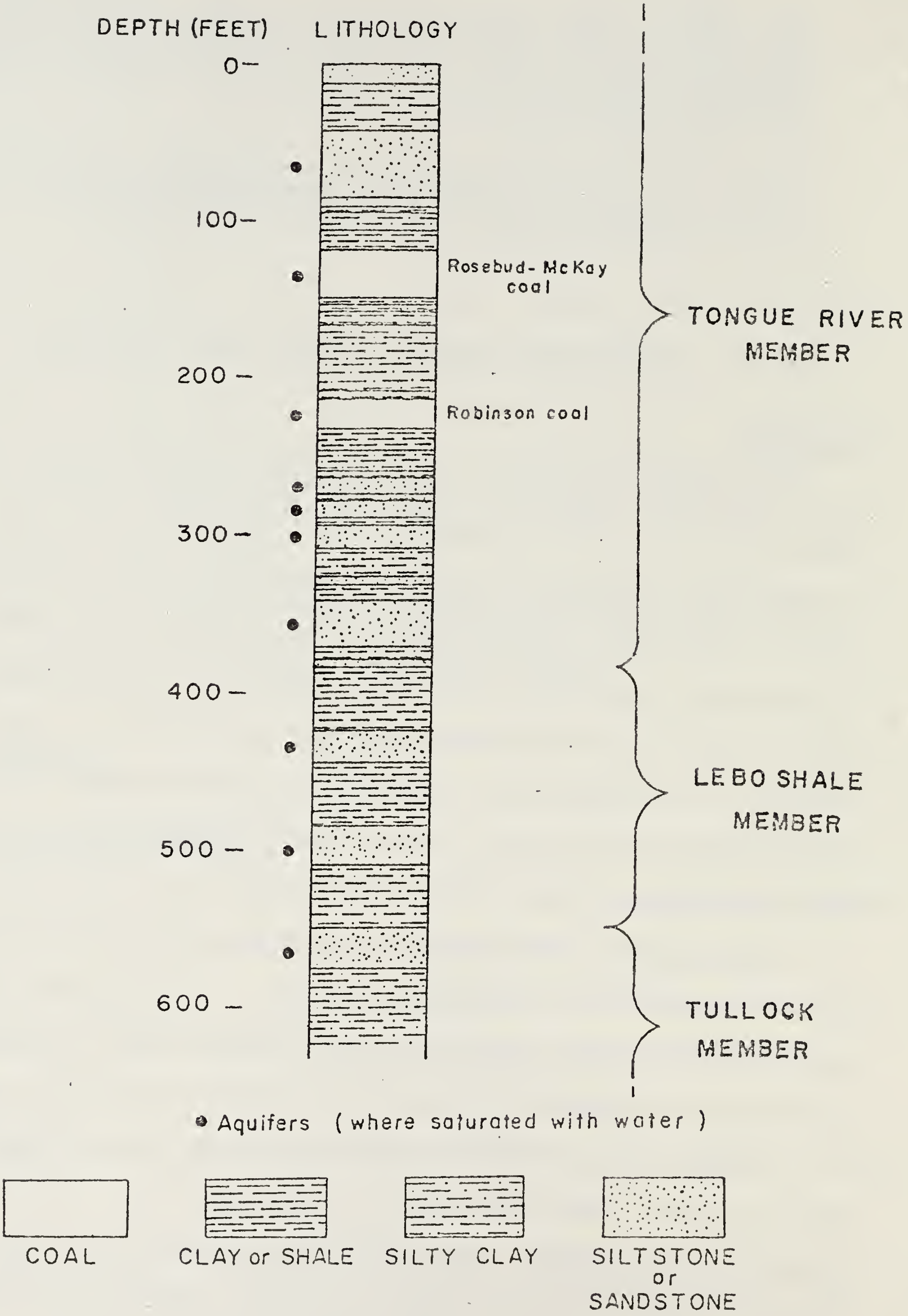

Figure: 1

Generalized stratigraphic column of part of Fort Union Formation in Westmoreland Resources Tract 3 near Sarpy Creek, southeastern Montana. Interpretations from borehole geophysical logs. (Van Voast, 1974).

A ground water observation network peripheral to the proposed mine area was established in 1973. Six groups of wells (17 altogether) were constructed to enable water-sample collections and water-level measurements for four aquifers within and below the stratigraphic section to be mined. Thus far, the water levels have reacted only to natural seasonal periods for recharge and discharge. (Van Voast, 1974).

Vegetation

Six vegetative community types were found on the proposed 1975-76 permit area. Figure 2 delineates those types while Table 1 explains the range condition and related information. Appendix II lists the major species found in each of the community types.

Wildlife

In September, 1974, the results of a four season wildlife survey of Westmoreland Resources' Tract III were given to the Department.

The most common game animals observed included mule deer, sharp-tailed grouse, and ring-necked pheasant. Others that were less common or seasonal were pronghorn antelope, whitetailed deer, Merriam's wild turkey, and Hungarian partridge. (ECS, 1974).

No critical wildlife habitat was found.

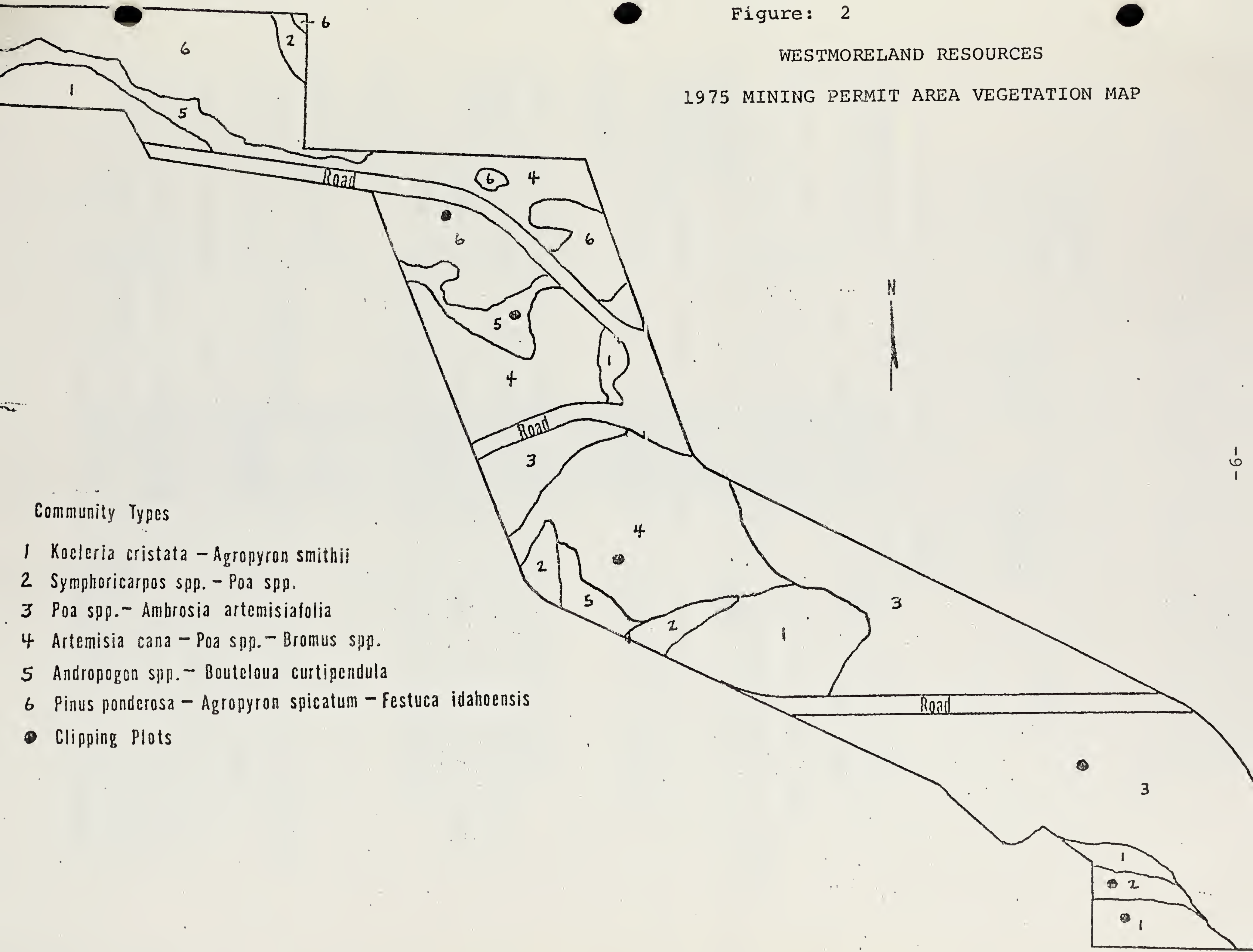

Figure: 2

WESTMORELAND RESOURCES

1975 MINING PERMIT AREA VEGETATION MAP

N
Road
Road
Road
Community Types
1 Koeleria cristata – Agropyron smithii
2 Symphoricarpos spp. – Poa spp.
3 Poa spp. – Ambrosia artemisiafolia
4 Artemisia cana – Poa spp. – Bromus spp.
5 Andropogon spp. – Bouteloua curtipendula
6 Pinus ponderosa – Agropyron spicatum – Festuca idahoensis
● Clipping Plots
1
2
3
4
5
6

TABLE 1

RANGE CONDITION CLASSIFICATION AND RECOMMENDED STOCKING RATES FOR SIX COMMUNITY TYPES ON WESTMORELAND RESOURCES 1975 MINING PERMIT AREA

Community Type and Code Number[1]	Extent[2]	Range Site[3]	Condition Classification[3]	Recommended Stocking Rate[3]
Koeleria cristata-Agropyron smithii	11%/ 6.9	Clay	26[4]/Fair	.30 AUM/ac.[5]
Symphoricarpos spp.-Poa spp.	3%/ 1.9	Silty	28 /Fair	.30 AUM/ac.
Poa spp.-Ambrosia artemisifolia	34%/21.4	Clay	18 /Poor	.15 AUM/ac.
Artemisia cana-Poa spp.-Bromus spp.	22%/13.9	Silty	17 /Poor	.15 AUM/ac.
Andropogon spp.-Bouteloua curtipendula	7%/ 4.4	Sandy	74 /Good	.45 AUM/ac.
Pinus ponderosa-Agropyron spicatum-Festuca idahoensis	16%/10.1	Sandy	66 /Good	.45 AUM/ac.

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[1] Code number corresponds with Figure 1.
[2] Total area consists of 63 acres; percent composition of the area/acreage.
[3] Follow SCS criteria.
[4] SCS value for condition classification.
[5] AUM/ac. = Animal Unit Months per acre.

MINING PLAN

The area to be mined contains two principal seams: the Rosebud-McKay, averaging thirty feet (30') in thickness, and the Robinson averaging twenty feet (20') in thickness and located approximately sixty feet (60') below the base of the Rosebud-McKay. Two stray seams also exist: Stray No. 1, averaging three feet (3') in thickness and lying around forty feet (40') above the Rosebud-McKay and Stray No. 2, occurring approximately five feet (5') below the Rosebud-McKay and averaging three feet (3') in thickness.

During 1974-75, only the Rosebud-McKay and Stray No. 2 seams were mined. In 1975-76, the Robinson will also be mined. The following averages indicate the quality of the coal to be mined:

	Rosebud-McKay	Stray No. 2	Robinson
Moisture	23.75	23.59	23.85
Ash	9.22	12.84	7.79
Sulphur	.61	1.53	.52
BTU	8573	8223	8594

The mining plan for 1975-76 is depicted in Exhibit 1, attached at the end of this statement.

COAL CONSERVATION - CHAPTER 220

All coal from the area proposed to be mined will be recovered with the exception of Stray No. 1. This seam, due to its location in relation to the crop line is oxidized and of no market value. However, as mining progresses away from the crop line, and Stray No. 1 becomes marketable, it will be mined and recovered.

Buffer zone requirements of the rules and regulations adopted pursuant to Chapter 325 prevent mining coal along the east and north property lines of the permit area. The tonnage left unmined will be approximately 312,000 tons.

LITERATURE CITED

Colorado School of Mines Research Institute. 1974. Study of overburden/interburden characteristics drill holes 391C, 414C, 440C, 441C and 442C, Big Horn County, Montana lease. July 23.

Colorado School of Mines Research Institute. 1974. Study of drill holes 298C, 489C and 490C, Big Horn County, Montana lease.

Ecological Consulting Service. 1974. Report to: Westmoreland Resources, Billings, Montana. Four season wildlife survey of the area known as Tract III. August.

Ecological Consulting Service. 1974. Report to: Westmoreland Resources. Range condition and production study, Sarpy Creek mining area (1975 mining permit area). September 10.

Van Voast, W.A. and R.B. Hedges. 1974. Hydrology of the area of Westmoreland Resources' Tract III reserves near Sarpy Creek, Southeastern Montana. September.

Westmoreland Resources. 1974. Application for mining permit - February 1, 1975 to January 31, 1976. July 24.

Westmoreland Resources. 1974. Mining plan for February 1, 1975 to February 1, 1976, pursuant to Chapter 220, Session Laws of Montana, 1973. September 4.

APPENDIX I

Chemical Analyses of Overburden/Interburden Samples
Drill Hole 189C

Sample No.	Depth, ft		Potassium Available ppm	Phosphorus $NaHCO_3$ Soluble ppm	Nitrate ppm	Ammonium ppm	Sulfate Water Soluble ppm (1)	Calcium Water Soluble ppm (1)	Magnesium Water Soluble ppm (1)	DTPA Extractable				Molybdenum Anion Exchangeable ppm	Boron Water Soluble ppm
	From	To								Cu ppm	Fe ppm	Mn ppm	Zn ppm		
111	0	5	315	1.1	<1	7	<1	60	20	1.6	68	20.0	30.4	0.46	1.6
112	5	12	235	0.4	<1	7	13	22	29	0.8	70	21.0	4.8	0.31	1.0
113	12	16	325	1.6	4	4	70	258	85	0.8	400	6.0	1.2	0.66	<1.0
114	20	25	225	1.1	36	19	1500	1780	460	1.6	460	7.4	2.0	1.03	3.0
115	25	31	225	1.0	1	6	176	164	89	2.0	124	21.2	2.0	0.69	1.2
116	31	36	230	0.6	<1	4	200	177	89	2.8	142	12.4	2.0	0.19	2.0
117	36	46	460	1.0	<1	11	115	177	112	2.8	126	7.2	15.0	0.63	<1.0
118	46	54	390	0.6	<1	9	94	80	38	2.8	176	16.2	8.0	0.47	1.2
119	54	61	570	0.8	<1	10	102	56	21	4.0	270	26.0	25.6	0.66	<1.0
120	61	68	485	0.2	7	12	82	24	6	5.0	156	12.4	31.8	0.60	1.4
121	68	71	640	0.3	7	16	139	14	4	7.4	192	16.0	10.4	0.40	2.6
122	71	79	460	0.2	<1	12	168	12	4	5.2	108	5.4	9.8	0.50	2.0
123	110	115	440	0.2	<1	9	68	2	2	7.4	50	2.6	11.6	0.60	2.0
124	119	126	560	0.2	<1	5	86	10	4	5.2	136	7.8	49.2	0.93	3.4
125	126	130	390	0.1	1	9	36	14	4	4.0	192	7.8	22.0	0.34	1.4
126	130	139	325	<0.1	<1	8	60	22	8	3.6	176	13.6	12.0	0.49	1.8
127	139	142	690	0.4	4	14	51	21	6	5.6	254	27.2	10.5	0.34	1.2
128	142	147	450	0.3	4	10	71	35	5	6.6	214	26.0	21.2	0.61	1.7
129	147	151	560	0.2	<1	9	128	10	4	11.0	244	32.0	16.2	0.31	2.5
130	151	161	510	0.2	<1	10	152	14	4	8.6	216	24.4	52.4	0.35	4.2
131	161	171	335	0.3	<1	3	96	24	4	2.4	180	16.0	22.4	2.06	2.7

1/ Determined on a 1 to 2 water extract

Chemical Analyses of Overburden/Interburden Samples
Drill Hole 489C

Sample No.	Depth, ft From	Depth, ft To	pH Water (1)	pH 0.01M $CaCl_2$ Solution (2)	Soluble Salts Extract Conductivity millimhos/cm (1)	Soluble Salts Extract Conductivity millimhos/cm (3)	Sodium Water Soluble (1) milliequivalents/100g	Sodium NH_4 Acetate Soluble milliequivalents/100g	Cation Exchange Capacity milliequivalents/100g	Exchangeable Sodium Percentage (4)	Sodium Absorption Ratio (5)
111	0	5	8.82	7.91	0.27	1.3	0.04	0.12	14.3	0.6	1.3
112	5	12	9.06	8.16	0.27	1.9	0.09	0.21	10.0	1.2	1.7
113	12	16	6.75	6.70	0.73	4.6	0.10	0.17	26.1	0.3	1.1
114	20	25	5.87	5.82	2.80	8.2	0.19	0.30	61.7	0.2	1.0
115	25	31	8.24	7.87	0.69	3.5	0.10	0.16	7.6	0.8	1.4
116	31	36	8.16	7.85	0.73	4.1	0.11	0.18	6.3	1.1	1.7
117	36	46	7.77	7.66	0.85	3.2	0.20	0.38	15.7	1.1	1.7
118	46	54	8.28	7.80	0.58	2.4	0.30	0.56	9.3	2.8	2.8
119	54	61	8.45	7.86	0.58	2.5	0.46	0.85	8.1	4.8	4.3
120	61	68	8.38	7.60	0.77	2.5	1.35	3.43	26.1	8.0	6.7
121	68	71	8.71	8.08	0.92	2.5	2.01	6.51	28.3	15.9	13.7
122	71	79	8.85	7.95	0.92	3.3	1.85	3.69	16.3	11.3	9.5
123	110	115	8.63	7.57	0.77	2.8	0.62	2.99	13.2	18.0	15.7
124	119	126	8.61	7.68	0.73	3.0	1.41	3.99	19.7	13.1	11.1
125	126	130	9.13	7.95	0.54	4.0	0.96	2.08	6.9	16.2	14.0
126	130	139	9.07	8.10	0.58	3.7	0.81	0.98	5.4	3.1	3.0
127	139	142	9.07	8.04	0.85	2.1	1.56	4.21	11.1	23.9	22.2
128	142	147	9.07	7.95	0.77	2.1	1.32	2.99	9.9	16.9	14.6
129	147	151	9.06	8.13	1.20	1.4	2.17	7.60	21.9	24.8	23.2
130	151	161	8.89	8.24	1.40	2.0	3.58	7.20	20.8	17.4	15.1
131	161	171	8.71	7.82	0.77	3.6	1.36	2.69	9.6	13.9	11.8
489-0	0	79	7.22	7.19	1.40	5.8	0.88	1.32	18.8	2.3	2.5
489-I	110	171	9.03	8.02	1.26	4.3	1.52	4.18	13.2	20.2	18.0

1/ Sample to extract ratio: 1 to 2
2/ Sample to extract ratio: 1 to 5
3/ Estimated conductivity for a saturation extract; basis, 1 to 2 ratio conductivity and 1/3 bar water-holding capacity data
4/ Calculated from the equation: exchangeable sodium percentage = $\frac{(100)(\text{Na, ammonium acetate soluble} - \text{Na, water soluble})}{(\text{cation exchange capacity})}$

5/ Calculated by USDA correlation from exchangeable sodium percentage: $\text{ESP} = \frac{100(-0.0126 + 0.01475\ \text{SAR})}{1 + (-0.0126 + 0.01475\ \text{SAR})}$

Chemical Analyses of Overburden/Interburden Samples
Drill Hole 489C

Sample No.	Depth, ft From	Depth, ft To	Selenium Available ppm	Arsenic Total ppm	Cadmium Total ppm	Fluoride Total ppm	Lead Total ppm	Mercury Total ppm	Nickel Total ppm	Emission Spectrographic Scan, Semiquantitative Estimates Aluminum ppm	Barium ppm	Silicon ppm	Strontium ppm	Titanium ppm
111	0	5	0.05	2	0.1	251	12	0.060	20	30,000	300	>100,000	<500	300
112	5	12	0.02	<2	0.1	203	16	0.085	16	30,000	300	>100,000	<500	3,000
113	12	16	0.03	2	0.1	155	5	0.035	15	30,000	300	>100,000	<500	3,000
114	20	25	0.02	5	0.2	314	3	0.500	17	30,000	300	>100,000	<500	3,000
115	25	31	0.02	<2	0.2	198	12	0.060	18	30,000	300	>100,000	<500	3,000
116	31	36	0.01	3	0.2	159	11	0.060	17	30,000	300	>100,000	<500	3,000
117	36	46	0.02	27	0.3	316	11	0.140	22	30,000	300	>100,000	<500	3,000
118	46	54	0.01	5	0.2	205	65	0.100	16	30,000	300	>100,000	<500	3,000
119	54	61	0.02	2	0.3	231	64	0.090	16	30,000	300	>100,000	<500	3,000
120	61	68	0.02	6	0.3	298	19	0.120	25	30,000	300	>100,000	<500	3,000
121	68	71	0.02	12	0.2	346	17	0.190	31	>100,000	300	>100,000	<500	3,000
122	71	79	0.01	2	0.2	187	14	0.120	22	30,000	300	>100,000	<500	3,000
123	110	115	0.03	5	0.2	224	19	0.150	20	>100,000	300	>100,000	<500	3,000
124	119	126	0.02	3	0.4	231	18	0.150	18	30,000	300	>100,000	<500	3,000
125	126	130	0.02	<2	0.2	188	10	0.120	16	30,000	300	>100,000	<500	3,000
126	130	139	0.01	<2	0.2	195	14	0.095	14	30,000	300	>100,000	<500	3,000
127	139	142	0.02	5	0.3	280	20	0.140	19	>100,000	300	>100,000	<500	3,000
128	142	147	0.02	2	0.3	218	14	0.080	24	30,000	300	>100,000	<500	3,000
129	147	151	0.02	2	0.3	267	18	0.110	30	>100,000	300	>100,000	<500	3,000
130	151	161	0.03	<2	0.3	207	14	0.090	23	30,000	300	>100,000	<500	3,000
131	161	171	0.03	<2	0.1	154	10	0.075	17	3,000	300	>100,000	<500	3,000

Chemical Analyses of Overburde[illegible]rburden Samples
Drill Hole 490C

Sample No.	Depth, ft From	Depth, ft To	pH Water (1)	pH 0.01M $CaCl_2$ Solution (2)	Soluble Salts Extract Conductivity millimhos/cm (1)	Soluble Salts Extract Conductivity millimhos/cm (3)	Sodium Water Soluble (1) milliequivalents/100 gm	Sodium NH_4 Acetate Soluble milliequivalents/100 gm	Cation Exchange Capacity milliequivalents/100 gm	Exchangeable Sodium Percentage (4)	Sodium Absorption Ratio (5)
132	0	5	8.91	8.36	0.31	1.3	0.08	0.42	13.2	2.6	2.7
133	5	10	8.73	8.41	0.85	3.7	0.74	1.41	12.8	5.2	4.8
134	10	18	8.55	8.39	1.2	10.3	0.62	0.78	9.6	1.7	2.1
135	18	28	8.55	8.13	0.65	4.9	0.31	0.61	9.1	3.3	3.2
136	28	35	8.72	7.99	0.54	5.0	0.18	0.39	7.8	2.7	2.7
137	35	39	8.45	7.99	0.73	4.0	0.15	0.32	9.9	1.7	2.1
138	39	45	8.16	8.03	1.20	7.6	0.15	0.32	7.6	2.2	2.3
139	50	57	7.64	7.29	0.77	2.5	0.20	0.34	25.1	0.6	1.3
140	57	65	8.33	7.85	0.54	2.5	0.15	0.32	9.1	1.9	2.3
141	65	74	7.73	7.37	0.62	2.2	0.50	0.87	19.7	1.9	2.3
142	74	78	8.15	7.39	0.62	1.9	0.85	2.10	24.5	5.1	4.7
143	110	114	8.83	7.54	0.31	1.1	0.57	2.91	13.8	17.0	15.2
144	118	127	8.52	7.76	1.20	2.9	2.73	7.20	27.1	16.5	14.2
145	127	134	8.97	7.92	0.69	2.6	1.14	2.91	10.5	18.4	16.1
146	134	138	8.98	7.89	0.62	2.5	1.02	2.17	11.1	10.4	8.6
147	138	148	9.21	8.01	0.69	2.6	1.11	2.78	14.3	11.7	9.9
148	148	153	9.15	7.99	0.77	2.3	1.34	4.64	10.2	32.4	33.4
149	153	163	9.14	7.96	0.62	2.7	1.00	2.00	6.9	14.5	12.4
150	163	173	9.03	8.00	0.92	3.3	1.47	4.25	13.7	20.3	19.0
490-0	0	78	8.10	7.70	0.73	3.5	0.38	0.69	14.8	2.1	2.2
490-I	110	173	8.96	7.91	0.85	2.9	1.33	3.47	16.3	13.1	11.0

1/ Sample to extract ratio: 1 to 2
2/ Sample to extract ratio: 1 to 5
3/ Estimated conductivity for a saturation extract; basis, 1 to 2 ratio conductivity and 1/3 bar water-holding capacity data
4/ Calculated from the equation: exchangeable sodium percentage = $\frac{(100)(\text{Na, ammonium acetate soluble} - \text{Na, water soluble})}{(\text{cation exchange capacity})}$

5/ Calculated by USDA correlation from exchangeable sodium percentage: $ESP = \frac{100(-0.0126 + 0.01475\ SAR)}{1 + (-0.0126 + 0.01475\ SAR)}$

Chemical Analyses of Overburden/Interburden Samples
Drill Hole 490C

Sample No.	From	To	Potassium Available ppm	Phosphorus $NaHCO_3$ Soluble ppm	Nitrate ppm	Ammonium ppm	Sulfate Water Soluble ppm (1)	Calcium Water Soluble ppm (1)	Magnesium Water Soluble ppm (1)	DTPA Extractable Cu ppm	DTPA Extractable Fe ppm	DTPA Extractable Mn ppm	DTPA Extractable Zn ppm	Molybdenum Anion Exchangeable ppm	Boron Water Soluble ppm
132	0	5	300	0.2	<1	3	9	50	40	2.4	88	15.6	4.0	0.25	1.4
133	5	10	195	0.9	3	4	187	54	90	2.0	148	26.0	2.0	0.29	1.4
134	10	18	190	<0.1	1	1	448	202	178	0.8	80	20.8	1.2	0.90	1.8
135	18	28	240	0.1	<1	<1	152	84	84	1.2	112	23.8	5.6	0.34	<1.0
136	28	35	260	0.2	3	1	112	70	72	1.2	86	16.6	2.8	0.14	<1.0
137	35	39	265	<0.1	<1	8	207	148	101	1.6	82	25.0	2.0	0.36	<1.0
138	39	45	245	0.4	<1	7	532	420	174	1.2	84	27.6	140.0	0.45	<1.0
139	50	57	410	0.2	<1	22	176	170	98	8.8	182	16.0	24.4	0.48	3.1
140	57	65	320	0.3	2	6	94	94	42	3.6	200	25.0	36.0	1.34	1.2
141	65	74	405	0.2	<1	6	106	100	30	4.0	212	26.0	15.0	2.07	1.0
142	74	78	530	0.2	4	11	114	66	12	7.4	70	8.6	22.4	0.55	2.7
143	110	114	425	0.3	<1	7	38	2	2	7.0	49	3.2	17.6	0.58	3.0
144	118	127	690	0.2	<1	9	259	14	4	5.4	180	11.6	140.0	0.53	5.1
145	127	134	410	<0.1	6	9	59	24	4	4.0	236	11.6	17.6	0.34	2.5
146	134	138	440	0.4	4	4	54	16	4	3.6	228	20.0	15.6	0.39	1.7
147	138	148	300	0.4	<1	6	42	43	6	3.6	214	15.2	44.4	0.37	<1.0
148	148	153	450	0.4	<1	7	68	6	2	6.2	176	14.0	164.0	0.63	2.5
149	153	163	275	0.2	<1	5	70	20	6	3.2	164	12.4	12.2	0.53	1.3
150	163	173	400	0.2	4	4	91	14	2	5.2	196	15.2	28.4	0.38	2.5

1/ Determined on a 1 to 2 water extract

Chemical Analyses of Overburden/Interburden Samples
Drill Hole 45 0C

Sample No.	Depth, ft		Selenium Available ppm	Arsenic Total ppm	Cadmium Total ppm	Fluoride Total ppm	Lead Total ppm	Mercury Total ppm	Nickel Total ppm	Emission Spectrographic Scan, Semiquantitative Estimates				
	From	To								Aluminum ppm	Barium ppm	Silicon ppm	Strontium ppm	Titanium ppm
132	0	5	0.03	2	0.1	241	9	0.045	18	30,000	300	>100,000	<500	3,000
133	5	10	0.02	2	0.1	256	10	0.040	16	30,000	300	>100,000	<500	3,000
134	10	18	0.02	<2	0.1	120	6	0.035	15	30,000	300	>100,000	<500	3,000
135	18	28	0.02	<2	0.1	115	5	0.040	18	3,000	300	>100,000	<500	3,000
136	28	35	0.02	<2	0.1	118	5	0.045	15	30,000	300	>100,000	<500	3,000
137	35	39	0.02	<2	0.1	180	9	0.050	19	3,000	300	>100,000	<500	3,000
138	39	45	0.02	2	0.1	170	8	0.055	15	3,000	300	>100,000	<500	3,000
139	50	57	0.02	40	0.2	234	20	0.210	25	>100,000	300	>100,000	<500	3,000
140	57	65	0.02	2	0.2	127	16	0.060	18	30,000	300	>100,000	<500	3,000
141	65	74	0.02	2	0.2	253	48	0.090	19	>100,000	300	>100,000	<500	3,000
142	74	78	0.03	10	0.3	286	27	0.430	27	>100,000	300	>100,000	<500	3,000
143	110	114	0.02	3	0.1	225	20	0.110	18	>100,000	300	>100,000	<500	3,000
144	118	127	0.02	40	0.2	266	24	0.200	20	>100,000	300	>100,000	<500	3,000
145	127	134	0.03	<2	0.1	143	14	0.095	15	30,000	300	>100,000	<500	3,000
146	134	138	0.04	<2	0.1	258	16	0.090	19	>100,000	300	>100,000	<500	3,000
147	138	148	0.03	<2	0.1	224	15	0.080	15	30,000	300	>100,000	<500	3,000
148	148	153	0.06	<2	0.1	136	14	0.070	27	>100,000	300	>100,000	<500	3,000
149	153	163	0.02	<2	0.1	196	9	0.065	14	3,000	300	>100,000	<500	3,000
150	163	173	0.02	3	0.2	240	16	0.150	15	30,000	300	>100,000	<500	3,000

Elements From Spectrographic Analysis For Hole No. SC-441

	Overburden					Interburden				
	W48 0-5	W49 10-15	W50 18.5-43.5	W51 43.5-60.0	W52 60.0-69.0	W53 99.0-104.5	W54 108.0-119.0	W55 119.0-152.0	W56 152.0-161.0	W57 180.0-191.0
Aluminum	3.000	3.000	3.000	10.00+	10.00+	3.000	10.00+	3.000	3.000	10.00+
Boron	.003	.003	.003	.003	.003	.003	.003	.003	.003	.003
Chromium	.003	.030	.030	.030	.030	.003	.030	.030	.003	.030
Copper	.003	.003	.003	.003	.003	.003	.003	.003	.003	.003
Iron	.300	3.000	10.00+	10.00+	10.00+	3.000	10.00+	3.000	3.000	10.00+
Lead			.003	.030	.030	.003	<.001	<.001	<.001	<.001
Manganese	<.001	<.001	.003	.030	.003	<.001	.003	.030	.030	<.001
Nickel			<.001	.003	.003	<.001	.003			.003
Silicon	10.00+	10.00+	10.00+	10.00+	10.00+	10.00+	10.00+	10.00+	10.00+	10.00+
Silver	<.001	<.001	<.001			.003	<.001	<.001	<.001	
Titanium	.030	.030	.030	.300	.300	.030	.300	.030	.030	.300
Tin						<.001				
Vanadium	.003	.003	.003	.030	.030	.003	.003	.003	.003	.030
Zinc	.030	.030	.030	.030	.003	.003	.030	.030	.030	.003
Zirconium	<.001	<.001	.003	.003	.003	<.001	.003	.003	.003	.003
Potassium				.300	.300					.300
Barium	.030	.030	.030	.030	.030	.030	.030	.030	.030	.030
Calcium	.300	.300	10.00+	10.00+	3.000	.030	3.000	10.00+	3.000	.300
Magnesium	.300	3.000	10.00+	10.00+	10.00+	3.000	10.00+	10.00+	3.000	3.000

Values given are percentage estimates.

Chemical Analyses of Overburden, Interburden and Composite Samples
Drill Hole SC-441

Sample No.	Depth, ft		pH Water (1)	pH 0.0. M $CaCl_2$ Solution (2)	Soluble Salts Extract Conductivity millimhos/cm		Sodium Water Soluble(1)	Sodium NH_4 Acetate Soluble	Cation Exchange Capacity	Exchangeable Sodium Percentage (4)	Sodium Absorption Ratio (5)	
	From	To			(1)	(3)	milliequivalents/100 g					
	Drill Hole SC-441											
W48	0	5	8.59	8.10		0.44	0.09	0.18	12.50	0.72		
W49	10	15	8.36	7.90		0.72	0.12	0.20	7.83	1.02		
W50	18.5	43.5	8.23	7.89		0.80	0.15	0.22	11.70	0.60		Overburden
W51	43.5	60.0	8.38	7.84		0.90	0.61	0.86	12.00	2.08		
W52	60.0	69.0	8.33	7.65		1.01	1.51	2.74	14.80	8.31		
W53	99.0	104.5	8.29	7.32		0.68	0.96	2.66	11.10	15.30		
W54	108.0	119.0	8.97	8.06		1.05	1.92	5.28	17.80	18.90		
W55	119.0	152.0	8.99	8.05		0.80	1.22	2.20	9.79	10.00		Interburden
W56	152.0	161.0	9.07	8.00		1.21	2.13	5.74	16.70	21.60		
W57	180.0	191.0	8.58	7.80		0.68	0.96	2.84	18.70	10.00		
48-52	0	69.0	8.33	7.83		0.80	0.56	0.78	12.00	1.83		Composite Overburden
53-56	69.0	191.0	8.96	7.98		1.05	1.74	3.28	12.20	12.60		Interburden

1/ Sample to Extract Ratio: 1 to 2

2/ Sample to Extract Ratio: 1 to 5

3/ Estimated conductivity for a saturation extract; basis, 1 to 2 ratio conductivity and 1/3-bar water holding capacity data

4/ Calculated from the equation: exchangeable sodium percentage = $\frac{\text{(100)(Na, ammonium acetate soluble - Na, water soluble)}}{\text{(cation exchange capacity)}}$

5/ Calculated by USDA correlation from exchangeable sodium percentage: $\text{ESP} = \frac{100(-0.0126 + 0.01475\ \text{SAR})}{1 + (-0.0126 + 0.01475\ \text{SAR})}$

APPENDIX II

SPECIES OCCURRING IN COMMUNITY TYPES
ON WESTMORELAND RESOURCES'
PROPOSED 1975-76 MINING AREA

Community Types	Grasses	Forbs	Shrubs
Koeleria cristata- *Agropyron smithii*	Junegrass *Koeleria crostata* Western wheatgrass *Agropyron smithii* Sandberg bluegrass *Poa secunda* Red three-awn *Aristida longiseta* Needle and thread *Stipa comata*	Low ragweed *Ambrosia artemisifolia* Fringed sagewort *Artemisa frigida* Spreading fleabane *Erigeron divergens* Purple prairie clover *Petalostemon candidum* Scurfpea *Psoralea spp*	Silver sagebrush *Artemisia cana* Broom snakeweed *Gutierrezia sarothrae*
Symphoricarpos spp.- *Poa spp.*	Kentucky bluegrass *Poa pratensis*	Cudweed sagewort	White snowberry *Symphoricarpos spp.* Silver sagebrush
Poa spp.-Ambrosia *artemisifolia*	Sandberg bluegrass Red three-awn Junegrass	Low ragweed Rush skeletonweed *Lygodesmia juncea* Common salsify *Tragopogon dubius* Fringed sagewort Scurfpea	Broom snakeweed
Artemisia cana-Poa spp.- *Bromus spp.*	Bluegrasses *Poa spp.* Cheatgrass *Bromus tectorum* Japanese chess *Bromus japonicus* Needle and thread Western wheatgrass	Salsify Yarrow *Archillea millefolium* Fringed sagewort Cudweed sagewort *Artemisia ludoviciana*	Silver sagebrush

SPECIES COMMUNITY TYPES - Continued

Community Types	Grasses	Forbs	Shrubs
Andropogon spp.-Bouteloua curtipendula	Little bluestem *Andropogon gerandi* Sideoats grama *Bouteloua curtipendula* Red three-awn Junegrass Idaho fescue *Festuca idahoensis*	Low ragweed Fringed sagewort Field checkweed *Cerastium arvense* Common salsify False-tarragon sagewort *Artemisia drancunculus*	Broom snakeweed Silver sagebrush Prairie Rose *Rosa arkansana*
Pinus ponderosa-Agropyron spicatum-Festuca idahoenis	Bluebunch wheatgrass *Agropyron spicatum* Idaho fescue Little bluestem Needle and thread	Yarrow Arrowleaf balsamroot *Balsamorhiza sagittata* Field chickweed Rose pussytoes *Antennaria rosea*	Snowberry Prairie rose

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